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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/560,723	04/28/2000	Shigeki Watanabe	837.1953/JDH	5245

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EXAMINER	
KIM, DAVID S	

ART UNIT	PAPER NUMBER
2633	

DATE MAILED: 10/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/560,723	WATANABE, SHIGEKI	
	Examiner	Art Unit	
	David S. Kim	2633	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 July 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3 and 6-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3 and 6-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☒ The proposed drawing correction filed on *28 July 2003* is: a)☒ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Drawings

1. The proposed drawing correction was received on 28 July 2003. This correction is approved.

2. Additionally, a clean copy of this corrected drawing (Fig. 7) was received on 28 July 2003 with the proposed drawing correction (Paper No. 10). This drawing is accepted by Examiner.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. **Claims 1-3, 6, and 8-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo et al. 10/97 ("All-optical fiber signal processing and regeneration for soliton communications") in view of Watanabe (U.S. Patent No. 5,596,667).

Regarding claim 1, Bigo et al. 10/97 discloses:

An optical device (Fig. 9) comprising:

an optical path (path from data input to clock output in Fig. 9) provided between an input port (data input in Fig. 9) to which signal light modulated at a frequency f_s (pp. 1215, col. 1, 2nd paragraph) is supplied and an output port (clock output in Fig. 9); and

an optical loop (loop in Fig. 9) optically coupled to said optical path;

said optical loop including:

an optical amplifier (EDFA in loop in Fig. 9) for compensating for a loss in said optical loop so that laser oscillation occurs in said optical loop;

an adjuster (optical delay line in Fig. 9, pp. 1215, col. 1, 1st paragraph) for adjusting an optical path length of said optical loop so that said frequency f_s becomes equal to an integral multiple of the reciprocal of a recirculation period of said optical loop; and

a nonlinear optical medium (pp. 1214, col. 2, last paragraph – pp. 1215, col. 1, 1st paragraph) for mode-locking said laser oscillation according to said signal light,

wherein amplitude modulation (pp. 1220, col. 2, last paragraph) is performed in said nonlinear optical medium.

Bigo et al. 10/97 does not expressly disclose:

wherein said nonlinear optical medium includes an optical fiber, and

amplitude modulation is performed in said nonlinear optical medium *by four-wave mixing using said signal light as pump light.*

However, amplitude modulation performed in a nonlinear optical medium by four-wave mixing using a signal light as pump light is known in the art. Watanabe teaches such amplitude modulation (Watanabe, Fig. 30, col. 26, lines 32-64). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to perform the amplitude modulation of Bigo et al. 10/97 in the nonlinear optical medium of Bigo et al. 10/97 by four-wave mixing using the signal light as pump light. One of ordinary skill in the art would have been motivated to do this since such amplitude modulation is an all-optical process (Watanabe, col. 25, lines 48-53), and "all-optical implementation is attractive because it removes the electronics bottleneck" (Bigo et al. 10/97, pp. 1220, col. 2, 1st paragraph under Section V).

Bigo et al. 10/97 still does not expressly disclose:

wherein said nonlinear optical medium includes an optical fiber.

Rather, Bigo et al. 10/97 discloses a variety of nonlinear optical media (SOA's, optical fiber in KFM's and NOLM's and SLALOM's, pp. 1215, col. 1, 1st paragraph), each medium providing a different option for implementing the optical device. Bigo et al. 10/97 only expressly

discusses amplitude modulation in SOA's. Bigo et al. 10/97 does not expressly discuss the types of modulation employed in the other nonlinear optical media options; Bigo et al. 10/97 neither affirms nor denies amplitude modulation in the other nonlinear optical media, which include an optical fiber.

The remaining question is whether or not it would be obvious to perform said amplitude modulation of Watanabe using a nonlinear optical medium that includes an optical fiber. The answer is yes. Watanabe teaches said amplitude modulation in a variety of nonlinear optical media (Watanabe, col. 27, lines 53-57) that includes the same variety of nonlinear optical media of Bigo et al. 10/97 (Bigo et al., SOA's, optical fiber). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to arrange said nonlinear optical medium of Bigo et al. 10/97 in view of Watanabe to include an optical fiber. One of ordinary skill in the art would have been motivated to do this since "an optical fiber is suitable as a non-linear optical medium from the matching property with an optical transmission line" (Watanabe, col. 27, lines 63-65).

Regarding claim 2, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, wherein said optical loop further comprises an optical bandpass filter (filter in loop in Fig. 9) having a passband including the wavelength of said laser oscillation.

Regarding claim 3, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, further comprising an optical coupler (50/50 coupler in Fig. 9) for optically coupling said optical path and said optical loop, said optical coupler providing a part of said optical path and a part of said optical loop.

Regarding claim 6, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, wherein said nonlinear optical medium comprises a single-mode fiber (Watanabe, col. 28, lines 8-11).

Regarding claim 8, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 6, wherein said nonlinear optical medium has a zero dispersion wavelength substantially equal to the wavelength of said signal light (Watanabe, col. 28, lines 14-16, 45-47).

Regarding claim 9, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, further comprising an input optical amplifier (EDFA connected to data input in Fig. 9) optically connected to said input port for amplifying said signal light.

Regarding claim 10, Bigo et al. 10/97 in view of Watanabe discloses all the limitations of claim 10 except for:

an optical bandpass filter optically connected between said input port and said input optical amplifier and having a passband including a wavelength of said signal light.

However, Bigo et al. 10/97 in view of Watanabe does teach such a filter used at a different location (filter in Fig. 3, pp. 975, col. 2, paragraph after Fig. 3). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to place another instance of this filter of Bigo et al. 10/97 in view of Watanabe between said input port and said optical amplifier of the device of Bigo et al. 10/97 in view of Watanabe. One of ordinary skill in the art would have been motivated to do this "to remove excess amplifier noise" (pp. 975, col. 2, paragraph after Fig. 3).

Regarding claim 11, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, further comprising an optical bandpass filter (filter connected to clock output in Fig. 9) optically connected to said output port and having a passband including a wavelength of light obtained by said laser oscillation.

Regarding claim 12, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 1, further comprising a waveform shaper (NOLM in Fig. 11) optically connected to said output port for performing waveform shaping of said signal light according to an optical clock output from said output port.

Regarding claim 13, Bigo et al. 10/97 in view of Watanabe discloses:

An optical device according to claim 12, wherein said waveform shaper comprises a nonlinear optical loop mirror (NOLM in Fig. 11).

Regarding claim 14, claim 14 is a system claim that corresponds largely to the device claim 1. Therefore, the recited means in device claim 1 read on the corresponding means in system claim 14. Claim 14 also includes a limitation absent from claim 1. This limitation is:

an optical fiber transmission line for transmitting signal light modulated at a frequency f_s.

Bigo et al. 10/97 in view of Watanabe also discloses such a transmission line (line connected to "1:2 clock recovery" unit in Fig. 11).

Regarding claims 15-16, claims 15-16 are system claims that correspond largely to the device claims 12-13, respectively. Therefore, the recited means in device claims 12-13 read on the corresponding means in system claims 15-16. Claims 15-16 also include limitations absent from claims 12-13. These limitations are also disclosed by Bigo et al. 10/97 in view of Watanabe:

an optical fiber transmission line (optical fiber link on pp. 1216, col. 1, last paragraph) for transmitting signal light; and

at least one optical repeater (amplifier on pp. 1216, col. 2, 1st paragraph) arranged along said optical fiber transmission line;

each of said at least one optical repeater comprising:

an optical clock regenerator (Fig. 9., pp. 1216, col. 2, 1st paragraph) for regenerating an optical clock by mode locking of laser oscillation according to said signal light.

Regarding claim 17, claim 17 is a method claim that corresponds to device claim 1. Therefore, the recited means in device claim 1 read on the corresponding steps in method claim 17.

5. **Claims 7 and 18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo et al. 10/97 in view of Watanabe as applied to claim 1 above, further in view of Watanabe et al. ("Simultaneous wavelength conversion and optical phase conjugation of 200 Gb/s (5x40 Gb/s) WDM signal using a highly nonlinear fiber four-wave mixer").

Bigo et al. 10/97 in view of Watanabe discloses all the limitations of claim 7 except for: said nonlinear optical medium comprising a highly nonlinear dispersion shifted fiber.

Watanabe et al. teaches such a nonlinear optical medium (Watanabe et al., pp. 1-2). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate a highly nonlinear dispersion shifted fiber as the nonlinear optical medium of Bigo et al. 10/97 in view of Watanabe. One of ordinary skill in the art would have been motivated to do this since doing so would enable one to practice the optical device of Bigo et al. 10/97 in view of Watanabe with a shorter length of fiber, providing a more compact optical device. Also, a highly nonlinear dispersion shifted fiber can have a higher third-order nonlinear coefficient than ordinary dispersion shifted fiber (Watanabe et al., pp. 2, 1st full paragraph). A higher coefficient value leads to higher conversion efficiency (Watanabe et al., pp. 1, last paragraph).

Regarding claim 18, Bigo et al. 10/97 in view of Watanabe, further in view of Watanabe et al., discloses:

An optical device according to claim 7, wherein said nonlinear optical medium has a zero-dispersion wavelength substantially equal to the wavelength of said signal light (Watanabe et al., pp. 1, last paragraph).

Response to Arguments

6. Applicant's arguments with respect to claims 1-17 have been considered but are moot in view of the new ground(s) of rejection.

7. Additionally, Applicant's arguments filed 28 July 2003 regarding Bigo et al. 10/97 have been fully considered but they are not persuasive. Applicant asserts, "Bigo et al. fails to disclose at least an optical fiber as a nonlinear optical medium for mode-locking the laser oscillation according to the signal light" (Paper No. 9, pp. 7, 2nd full paragraph). Examiner respectfully disagrees. Bigo et al. 10/97 does disclose such an optical fiber (Bigo et al. 10/97, actively mode-locked lasers, pp. 1214, col. 2, last paragraph, line 3; optical fiber in KFM's, NOLM's, and SLALOM's, pp. 1215, col. 1, 1st paragraph, lines 11-14). Accordingly, Examiner respectfully maintains the standing rejections.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fontana et al. is cited to show a related optical device that uses four-wave mixing in a nonlinear optical medium.

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Kim whose telephone number is 703-305-6457. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jason Chan can be reached on 703-305-4729. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-4750.

DSK

JASON CHAN
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